



National Aeronautics and
Space Administration

Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California

Welcome and Innovation at JPL

Presentation to

NASA Advisory Council

5 August 2010

Charles Elachi, Director
NASA Jet Propulsion Laboratory
California Institute of Technology



National Aeronautics and
Space Administration

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California Institute of Technology
Pasadena, California

JPL: From Caltech students testing rockets to exploring the planets in our lifetime



Caltech students (1936)



Missiles (1940s)



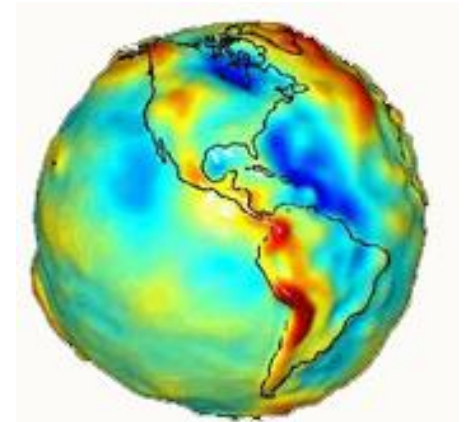
Explorer 1 (1958)



Planetary Missions
(1960 – present)



Astrophysics Missions
(1983 – present)



Earth Science Missions
(1978 – present)



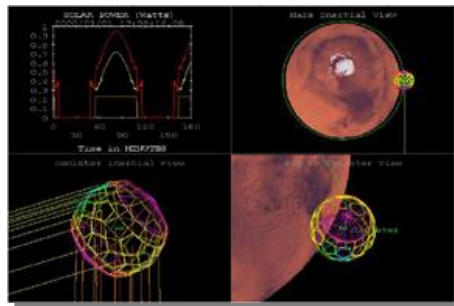
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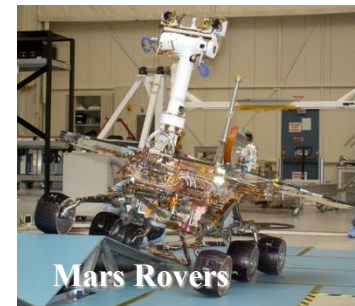
End-to-end capabilities needed to implement missions



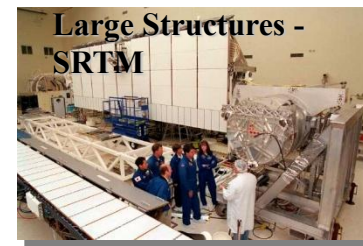
Project Formulation - Team X



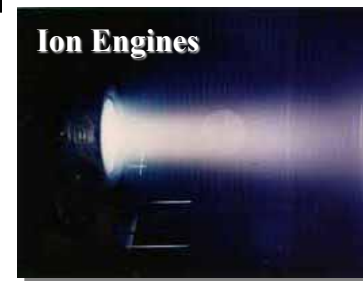
Mission Design



Mars Rovers



Large Structures -
SRTM



Ion Engines



Integration and
Test



Environmental
Test



Real Time Operations



Scientific Research





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MER and MSL Entry-Descent-Landing





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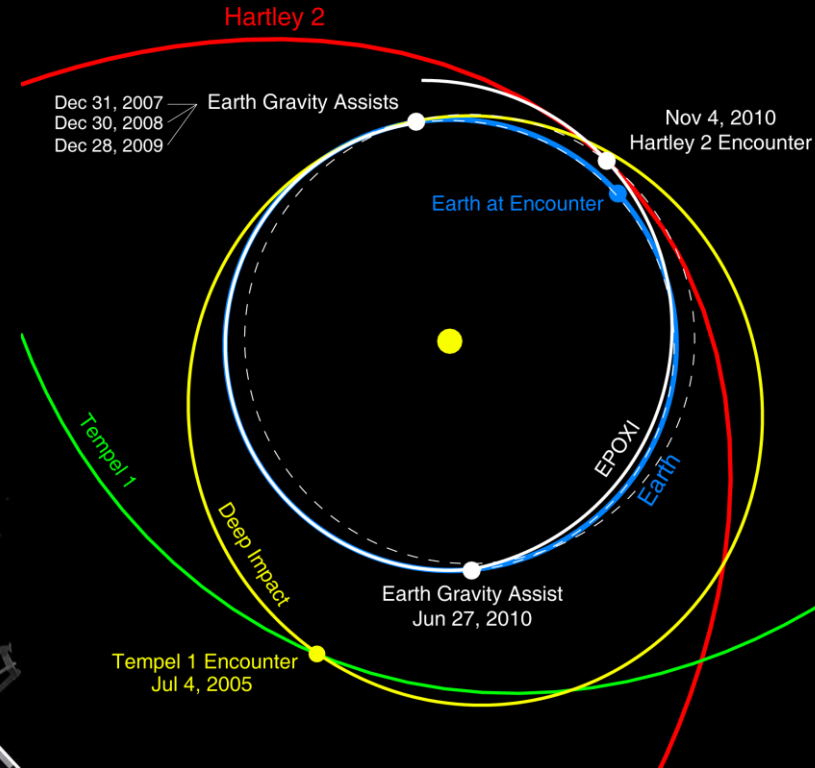
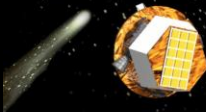
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EPOXI: A New Mission for Deep Impact



Launched
Jan 12, 2005

**Tempel-1
Encounter**
July 4, 2005



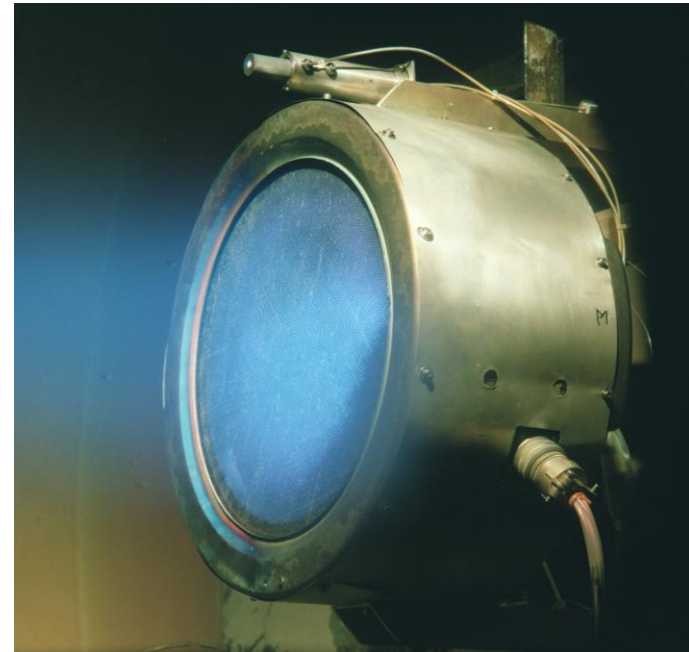
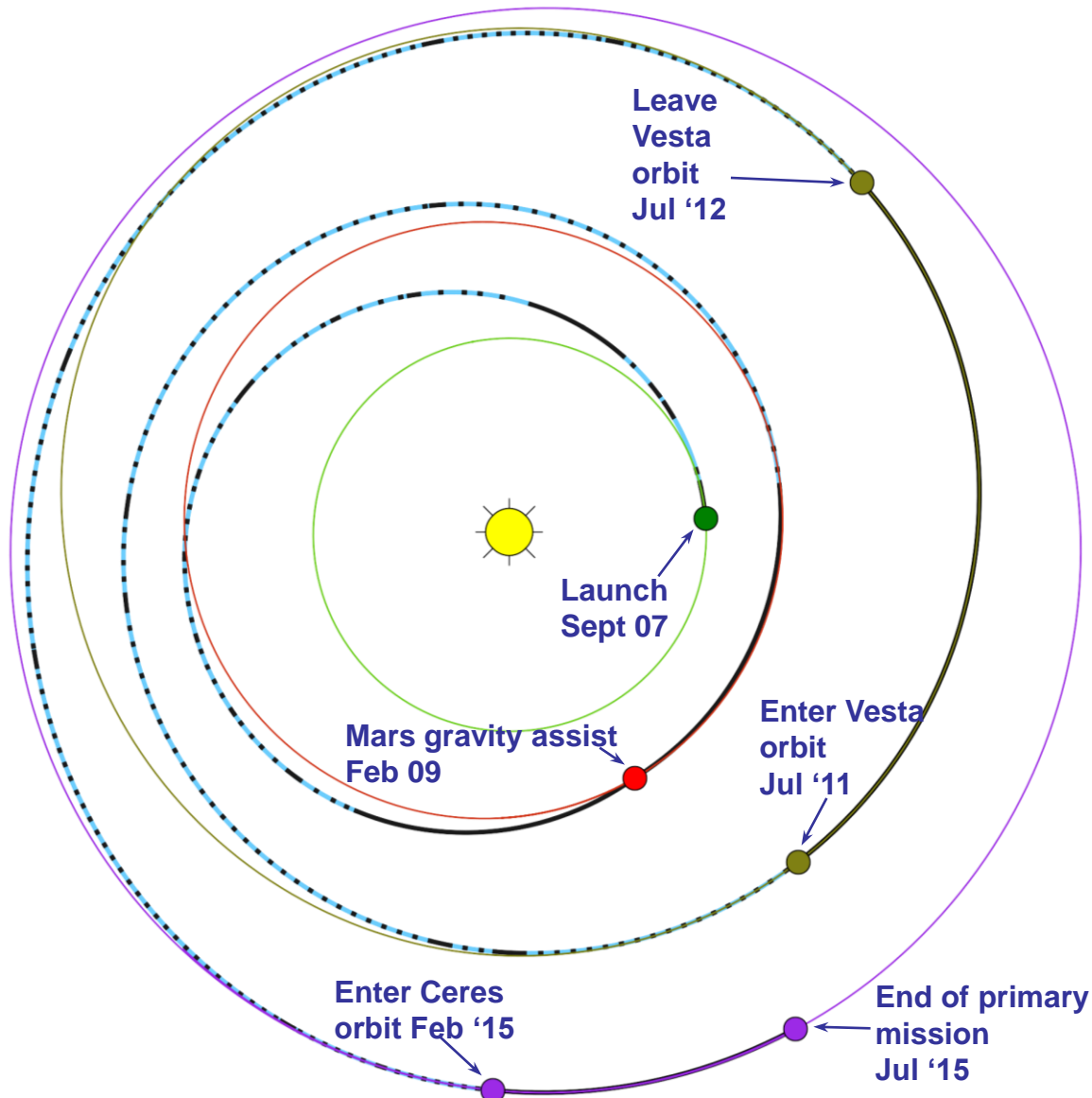
**Hartley-2
Flyby**
November 4, 2010



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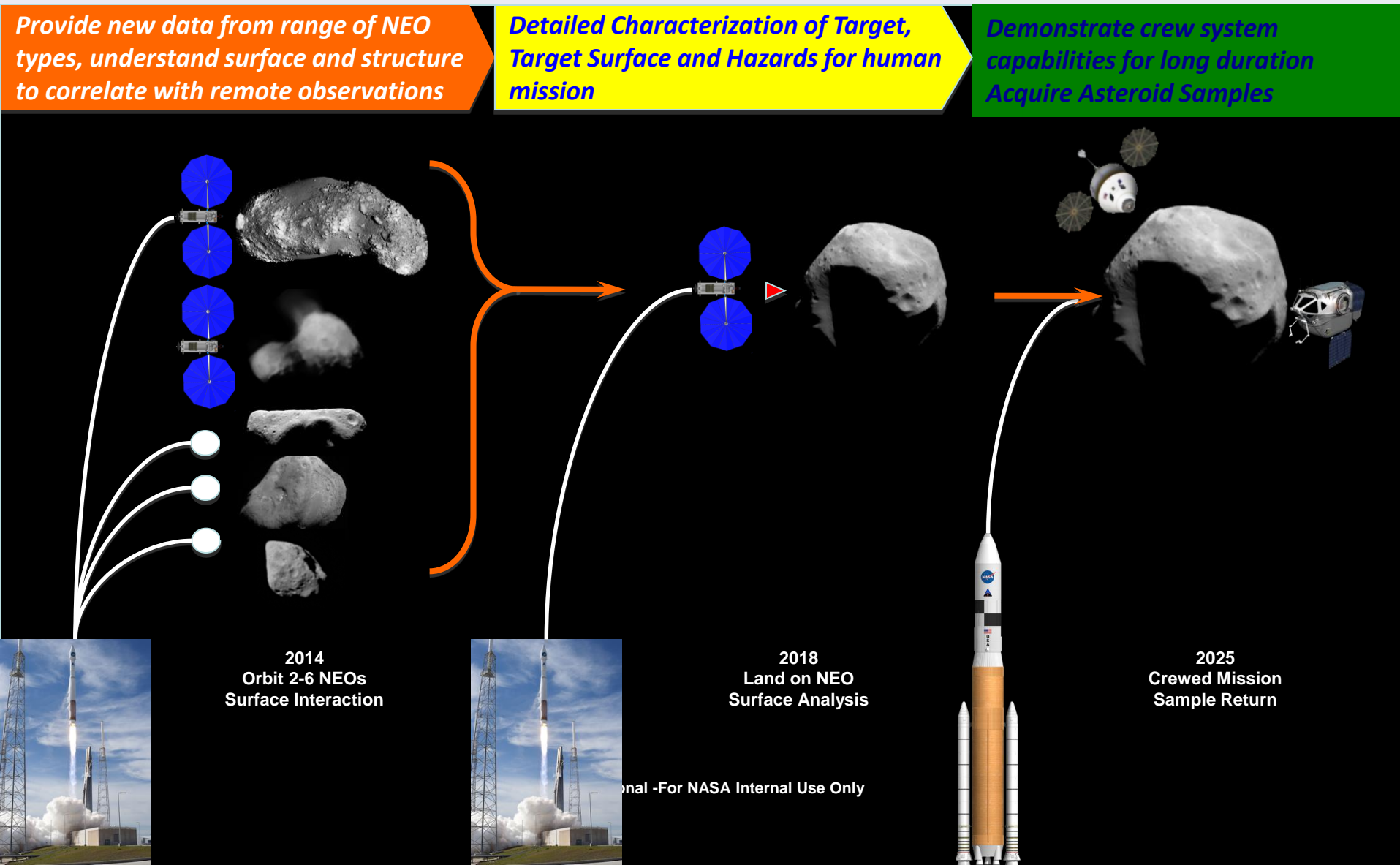
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Dawn's Exploration of New Worlds in the Main Asteroid Belt



- A mission to orbit both Vesta and Ceres would be impossible without ion propulsion.
 - Dawn will be the first spacecraft ever to orbit two solar system targets.
- Even a mission only to Vesta would be unaffordable for the Discovery Program without ion propulsion.

A Step-Wise NEO Campaign

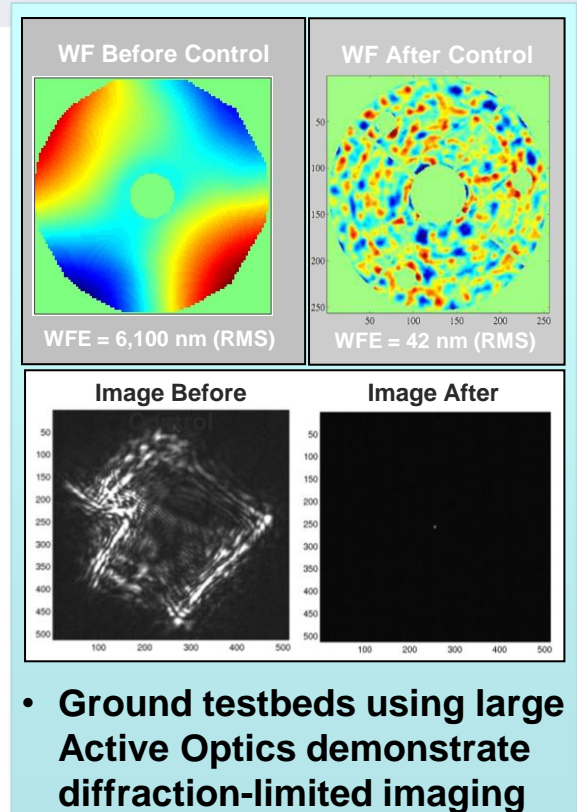
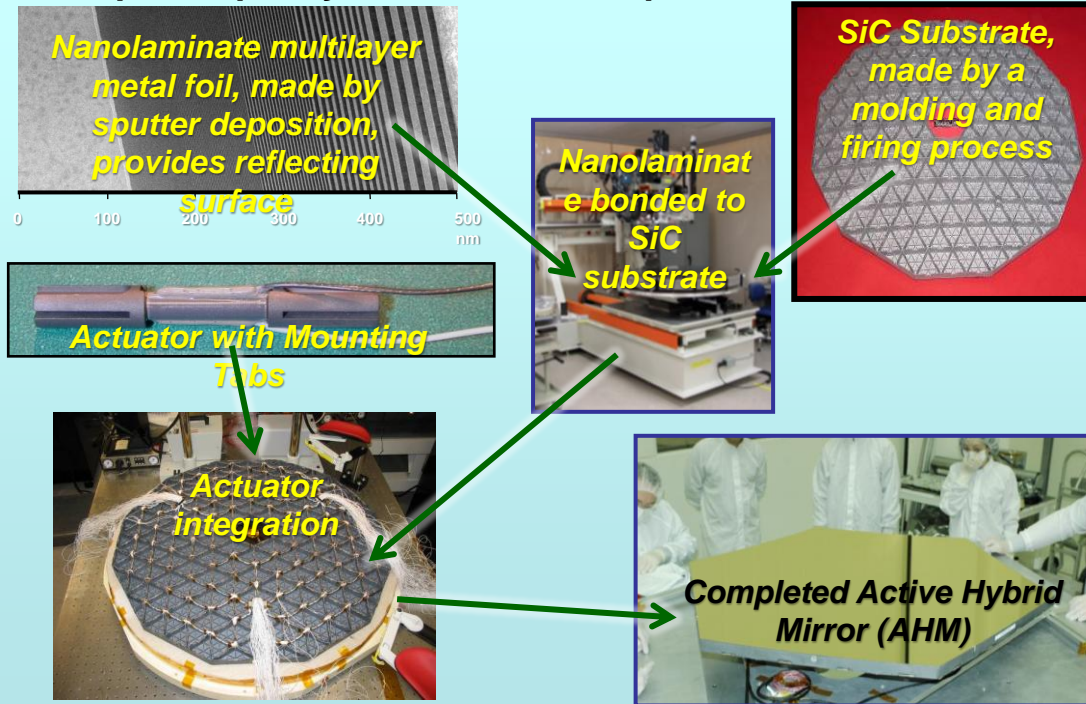




Active Optics for Space Telescopes



- AHMs are active mirrors *made by replication* for high optical quality, low cost, and rapid fabrication



- Active optics technologies...
 - Reduce mission risk by correcting virtually any optical error after launch.
 - Accelerate production by relaxing fabrication and alignment tolerances.
 - Compress costly I&T phase.
 - Enable large deployed apertures for future large telescope missions.

- Nanometer-precision laser metrology for control of segmented mirrors

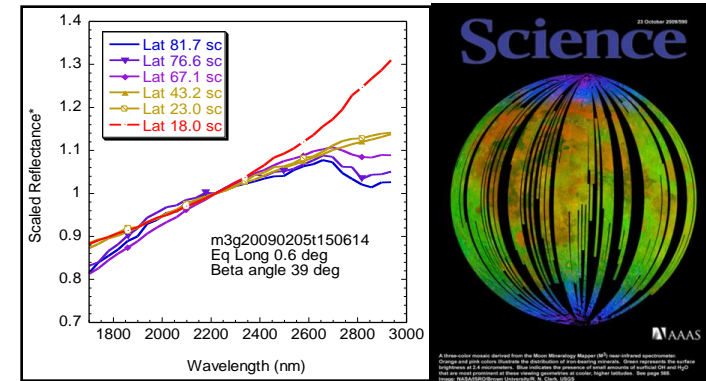
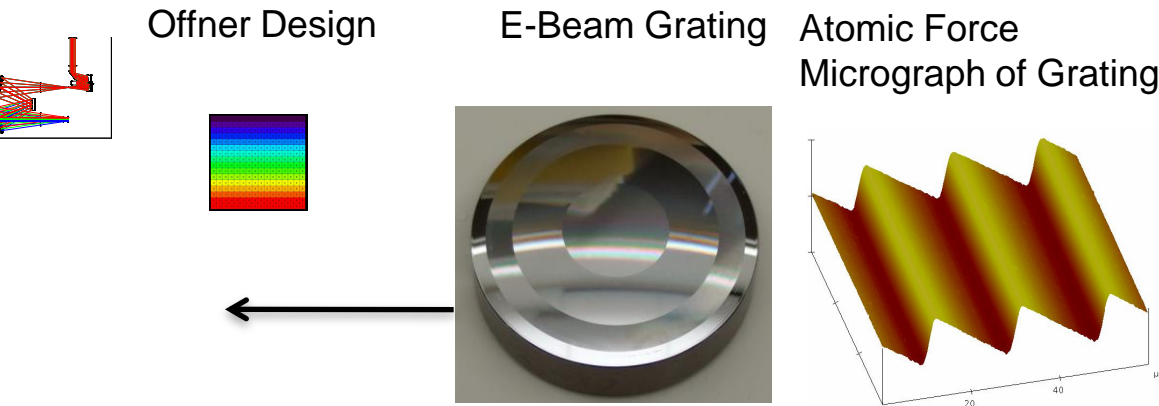




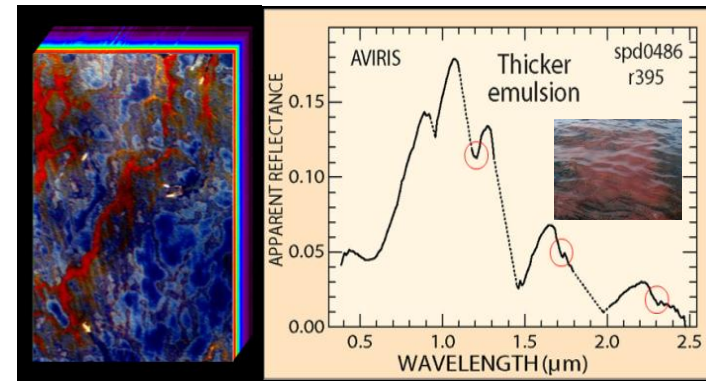
Imaging Spectrometer Instrument Innovation for NASA Science and Discovery



- Advanced spectrometer designs are enabled by curved multi-blaze e-beam grating.



- In 1989, the proposed HIRIS Imaging Spectrometer was 970 Kg, 879 W and the size of small car.
- Today, the HypsIRI Earth Decadal Survey instrument is 55 Kg and 41 W, compact and provides a superior science measurement.





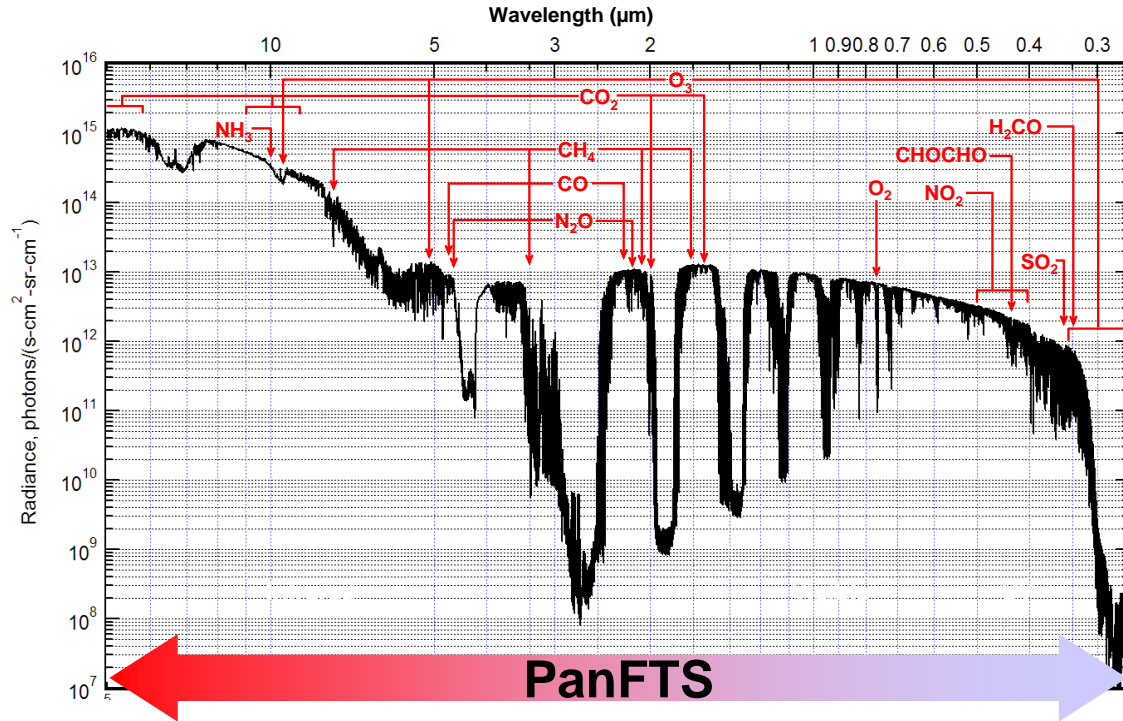
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Panchromatic Fourier Transform Spectrometer (PanFTS)



Earth Spectrum (Tropical noon, albedo 0.8)



- PanFTS is an innovative new instrument concept for atmospheric remote sensing
- PanFTS has wide spectral sensitivity for simultaneous observations of reflected sunlight and thermal emission enabling measurement of numerous atmospheric composition species such as
 - Pollutants: O₃, NO₂, NH₃, SO₂, HCHO, CH₃OH, CO
 - Greenhouse Gases: CO₂, CH₄, N₂O, O₃, H₂O
 - Transport Tracers: HDO, N₂O, O₂, O₄
- From geostationary orbit PanFTS can make hourly measurements to capture rapidly changing atmospheric chemistry over all of North and South America



AIRS TES IASI

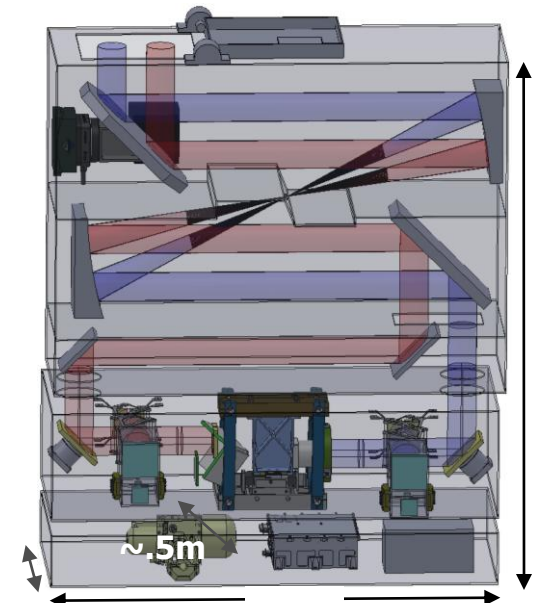


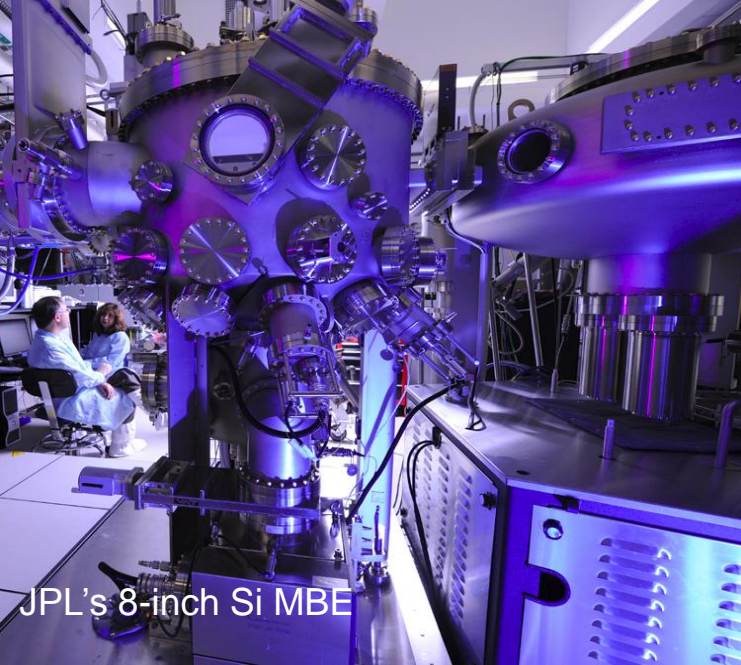
GOSAT



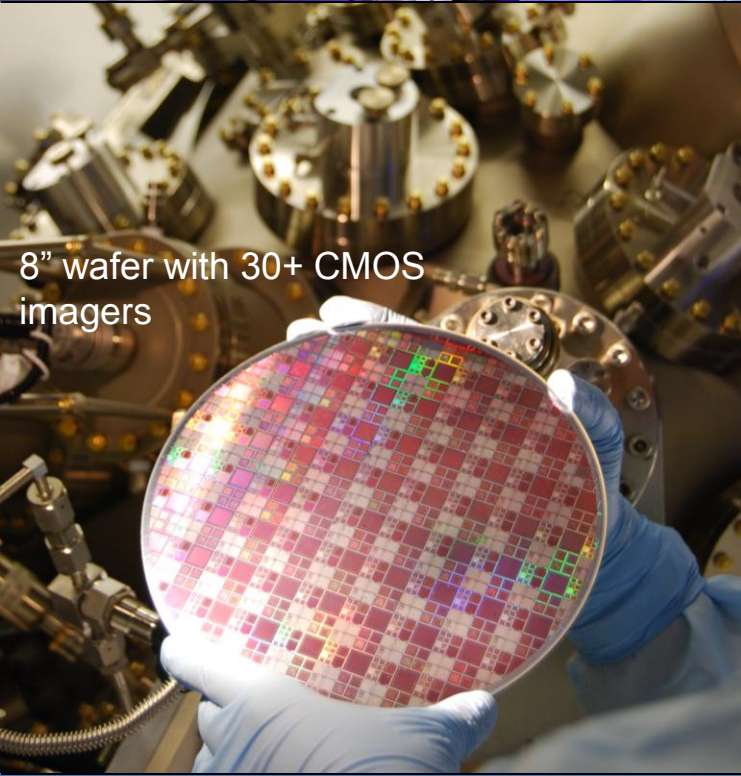
OMI
SCIAMACHY

PanFTS has the measurement capabilities of
several satellite instruments combined





JPL's 8-inch Si MBE



8" wafer with 30+ CMOS imagers

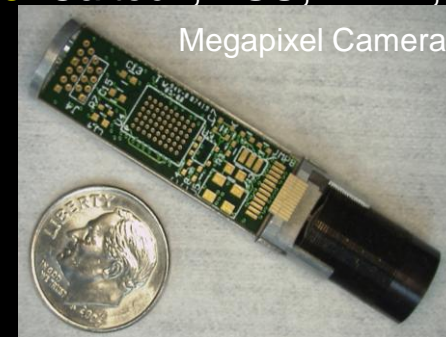
High Performance Gigapixel Focal Plane Arrays

High Performance Detectors: JPL-invented delta doping technology enables world record sensitivity and stability in UV-Vis-NIR.

High Capacity MBE: JPL-unique facility at Microdevices Laboratory allows batch processing/delta doping of Silicon imager wafers up to 8 inches in diameter.

Gigapixel focal plane arrays: JPL investments in advanced FPA technologies such as MBE, unique coatings, curved FPAs, packaging, and testing are pushing the frontiers of imaging and spectroscopy for NASA missions and reimbursable customers.

Partnerships: Caltech, ASU, LBNL, e2v, etc.



Megapixel Camera



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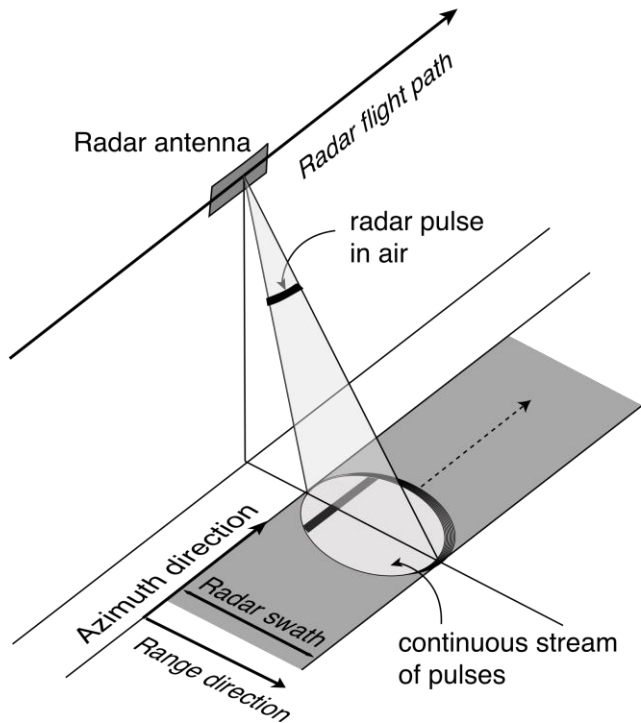
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DESDynI SweepSAR – First-of-a-kind Scan-on-Receive Radar



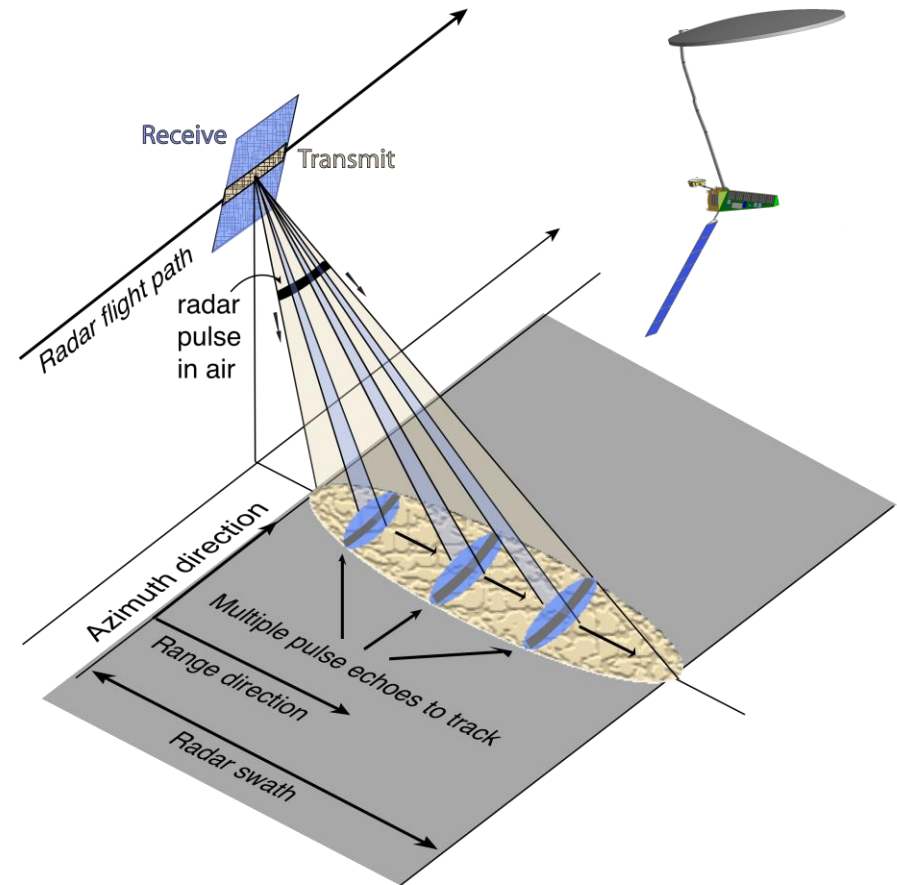
Conventional SAR

- LIMITED SWATH
- One pulse in swath at a time



SweepSAR

- ULTRAWIDE SWATH
- Track multiple pulses in swath





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Deep Space Communications

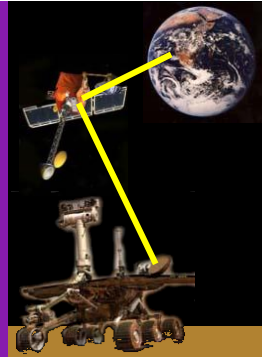


The power received by the 70m DSN antenna from Voyager is so small that if it were to be accumulated for 10 trillion years it could power a refrigerator light bulb for one second!



Orbiting Mars relays enabled a 5X increase in science

- Each MER returned 15 Gb in the first 3 months using relays – 5X as much as Pathfinder
- Nearly all data from Mars' surface comes via relays today

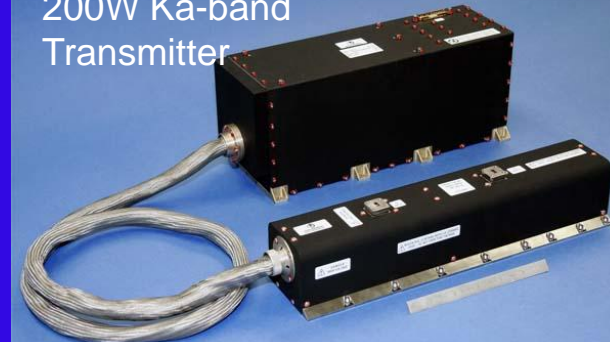


Overall return increased 10X over the last decade:
from 100's of Kbps to 6 Mbps at Mars, for example

The technology is already in hand for the next 10X

- Ka-band, advanced coding, arraying of ground antennas

200W Ka-band
Transmitter





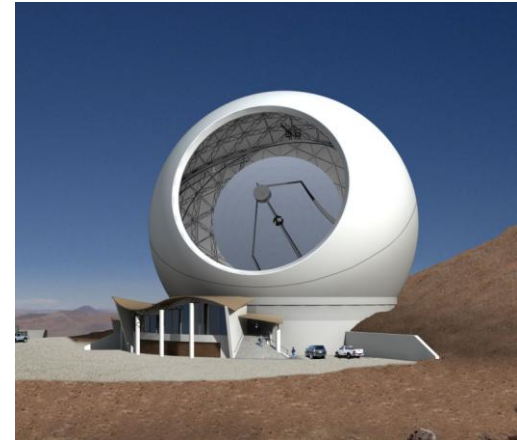
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Caltech Science and Technology Benefit JPL and NASA



- Access to Caltech research facilities
 - Keck Observatory
 - Palomar Observatory
 - Owens Valley Radio Observatory
 - Cornell Caltech Atacama Telescope
 - Beckman Institute
 - Kavli Nanoscience Institute
- Caltech - JPL Joint Appointments
 - Appointments of Caltech faculty to JPL: 4
 - JPL appointments at Caltech: 74
- Caltech's emphasis on excellence pervades JPL's research
- World-class researchers are attracted to JPL because of affiliation with Caltech
- Caltech brings intellectual depth to JPL research topics
 - Planetary science
 - Radar studies of solid Earth
 - Gravitation wave studies
 - Atmospheric chemistry
 - Cosmic Microwave Background research



Cornell-Caltech Atacama Telescope



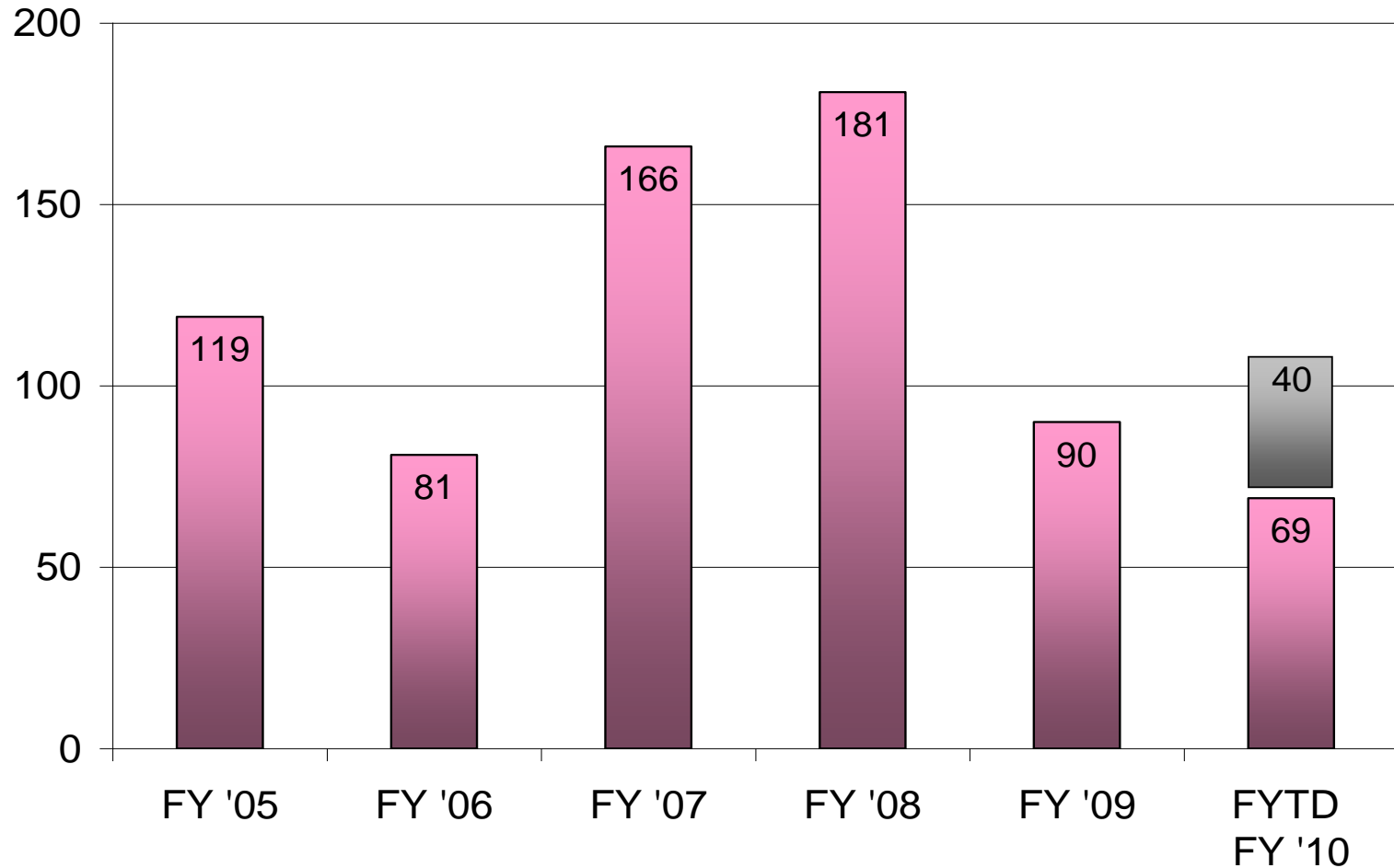
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JPL Early Career Hires

FY '05 through fiscal month-end June 27, 2010 (Q3 FY'10)



Early Career Hires (ECHs)



HIGH TECH



Eyes on the Earth

Tracking NASA spacecraft,
their data and positions
in Earth orbit.

HIGH TOUCH



Summer Student JPL Internships

>450 Students

Imagine Mars Project:

> 10,000 Participants so far

Mars Student Imaging Project

at Arizona State University:

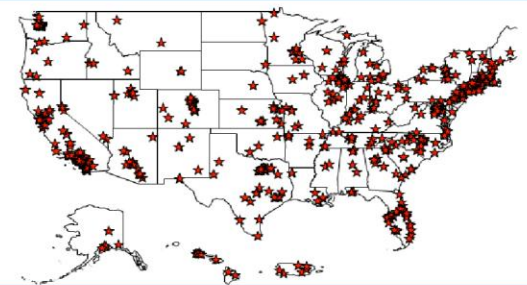
>15,000 Students so far

Reading Writing and Rings

(Reading Skills through Exploring Saturn)

> 3000 Teachers trained

HIGH IMPACT



Solar System Ambassadors:
500 Nationwide



Museum Alliance, now for all of NASA:
400 Institutions



Night Sky Network:
> 350 Amateur Astronomy Clubs